REMARKS

Claim Rejections under 35 U.S.C. § 102/103

The Examiner has rejected claims 1-14 and 28-33 under 35 U.S.C. § 102(e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious under Mravic, et al. (US Patent No. 6,083,840).

It is Applicant's understanding that the cited reference fails to teach or anticipate Applicant's invention as claimed in claims 1-14 and 28-33. In claims 1-10 and 28-33, Applicant claims a method for forming a copper interconnect including forming a dielectric layer, forming a copper diffusion barrier over the dielectric, depositing copper over the diffusion barrier and dielectric, and polishing the copper with "a high pH slurry having less than or equal to 10 %wt of abrasive." In claims 11-14, Applicant specifies a slurry that forms a protective coating over the copper during polishing. The polishing method as claimed by Applicant reduces the extent of erosion, recess, and dishing that occurs in other copper polishing methods.

Mravic teaches a two-step chemical mechanical polishing (CMP) process for polishing a copper layer including: 1) a bulk slurry and 2) a Cu/Ta/SiO_2 slurry. The bulk slurry step of the CMP process utilizes a slurry having 1-12 wt% of abrasive and a low pH of 3-5 (column 7, Table 2). Conversely, as discussed above, Applicant claims a high pH copper polishing slurry. Thus, Mravic's bulk slurry fails to teach or render obvious the high pH of Applicant's slurry. Also, in Mravic's second step, he teaches a Cu/Ta/SiO_2 slurry with 15-30 wt% of abrasive and a high pH of 9-11 (column 8, Table 3). Although this second slurry has a high pH, it fails to teach or render obvious Applicant's claimed slurry having "less than or equal to 10 wt% of abrasive." Thus, Mravic fails to teach or suggest Applicant's copper polishing slurry having a high pH and 2-10 wt% of abrasive. Applicant respectfully submits that Mravic fails to teach each and every element of Applicant's invention under 35 U.S.C. § 102(e) or render Applicant's invention obvious under 35 U.S.C. § 103(a).

Contrary to the Examiner's position, Mravic does not teach his high pH slurry as having less than or equal to 10 wt% of abrasive. As discussed above, Mravic's high pH slurry, the $Cu/Ta/SiO_2$ slurry, has 15-30 wt% of abrasive and his separate copper bulk slurry, the low pH slurry, has 1-12 wt% of abrasive (column 7, Table 2 and column 8, Table 3). It is the Applicant's understanding that the Examiner appears to be combining elements of Mravic's two distinct slurries. Mravic neither teaches nor suggests combining elements of the bulk slurry and the $Cu/Ta/SiO_2$ slurry. Thus, there is no motivation, nor is it proper, to combine various elements of Mravic's two distinct slurries to obtain the copper polishing slurry claimed by Applicant.

In claims 11-14, Applicant claims a method of polishing a copper film with a slurry having a pH and a composition such that a protective layer is formed on the copper being polished. Nowhere does Mravic teach, describe, or suggest a method of polishing a copper layer with a slurry such that a protective layer is formed on the copper. Additionally, Mravic's methods for polishing copper with a slurry do not inherently form a protective layer on the copper. In order for such a protective layer to be formed, the slurry must fall into the passivation region of the Pourbaix diagram (see fig. 5 of Application). The passivation region is defined by a specific range of pH (horizontal axis) and electric potentials (vertical axis). It is the Examiner's position that a protective layer is formed on copper by polishing with Mravic's high pH slurry (i.e., Mravic's $Cu/Ta/SiO_2$ slurry). Applicant respectfully disagrees. Mravic fails to teach or suggest an electric potential of the slurry, let alone an electric potential in the passivation region as defined by the Pourbaix diagram. Without knowing the electric potential of Mravic's high pH slurry, one cannot know whether his high pH slurry falls within the passivation region of the Pourbaix diagram. Thus, Mravic fails to teach or render obvious Applicant's method of polishing a copper film "with a slurry having a pH and a composition such that a protective layer is formed over the copper film during polishing."

Claim Rejections under 35 U.S.C. § 103

The Examiner has rejected claims 6, 8, 9, and 10 as being unpatentable over Mravic under 35 U.S.C. § 103(a). It is the Examiner's position that one of ordinary skill in the art at the time of the claimed invention would have found it obvious to adjust the parameters of Mravic's two processes to obtain the invention claimed by Applicant. Applicant respectfully disagrees.

Claims 6, 8, 9, and 10 depend directly or indirectly on claim 1. Therefore, these dependent claims include all of the limitations of claim 1 and further limitations. Thus, for at least the same reasons advanced above, Applicant respectfully submits that Mravic did not render these dependent claims obvious.

If there are any additional charges, please charge Deposit Account No. 02-2666. If a telephone interview would in any way expedite the prosecution of this application, the Examiner is invited to contact the undersigned at (408) 720-8300.

Respectfully submitted,

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